PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-087024
(43)Date of publication of application : 06.04.1993

(51)Int.Cl. F02M 69/00
F01M 13/00
F02M 29/00
F02M 69/04

(21)Application number : 03-247219
(22)Date of filing : 26.09.1991

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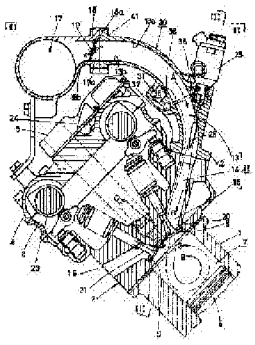
(54) AIR INTAKE DEVICE OF ENGINE



(57)Abstract:
PURPOSE: To attempt compatibility between promotion of fuel carburetion/atomization caused by fuel injection to high flow speed intake air, and improvement of filling efficiency caused by high level maintenance of average flow speed, and also achieve improvement of scavenging property or the like simultaneously, in the air intake device of a fuel injection type engine provided with an air intake passage having a curved part.
CONSTITUTION: The air intake device of an engine is provided in such constitution that an injector 25 is arranged in an air intake passage 12

having a curved part 13, and also an appropriate quantity of additional gas G is supplied into the intake passage 12. The injection hole 26 of the injector 25 is opened to the curved part 13 of the intake passage 12, or to the immediately downstream position of the curved part 13, and also on the wall surface 13a on the outer circumference side of the curved part 13. On the other hand, the injection part 36 of aditional gas G is opened on the wall surface 13b on the inner circumference side of the curved part 13.

LEGAL STATUS

[Date of request for examination]	27.07.1998
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3071260
[Date of registration]	26.05.2000
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] In the suction system of the engine which supplied proper

addition gas in this inhalation-of-air path while having arranged the injector to the inhalation-of-air path which has a bend It is the suction system of the engine characterized for the nozzle hole of the above-mentioned injector by the thing of the direct down-stream location of the bend of the above-mentioned inhalation-of-air path, or this bend which the jet section of the above-mentioned addition gas did for opening of this on the wall surface by the side of the inner circumference of the above-mentioned bend while carrying out opening on the wall surface by the side of the periphery of this bend moreover.
[Claim 2] In the suction system of the engine equipped with the closing motion valve open from this injector and close the above-mentioned inhalation-of-air path alternatively according to engine operational status to the upstream while having arranged the injector to the inhalation-of-air path which has a bend While carrying out opening of the nozzle hole of the above-mentioned injector on the wall surface by the side of the periphery of the above-mentioned bend While arranging the above-mentioned closing motion valve near the upper edge of the above-mentioned bend in the condition of having turned in the direction which constitutes this from a butterfly valve and intersects perpendicularly the direction of a valve stem in the direction of a curve side of the above-mentioned bend The suction system of the engine characterized by setting up the valve-opening actuation direction so that it may be located in the inhalation-of-air downstream rather than the periphery section to which the periphery section located in the periphery side of the above-mentioned bend at the time of the valve opening is located in an inner circumference side.
[Claim 3] In the suction system of the engine which supplied proper addition gas in this inhalation-of-air path while having arranged the injector to the inhalation-of-air path The upstream bend which curves so that it may turn being located in the upstream and inhalation-of-air applying [above-mentioned] it to the side from the engine upper part, The bay prolonged in the shape of a straight line to a slanting lower part succeeding the down-stream edge of this upstream bend, While constituting from a downstream bend which curves to an opposite direction and is open for free passage to a suction port with the above-mentioned upstream bend succeeding the down-stream edge of this bay and carrying out opening of the nozzle hole of the above-mentioned injector on axial center extension of the above-mentioned bay The suction system of the engine characterized by carrying out opening of the jet section of the above-mentioned addition gas on the inner circumference side-attachment-wall side of the above-mentioned upstream bend.

[Claim 4] In the suction system of the engine which supplied proper addition gas in this inhalation-of-air path while having arranged the injector to the inhalation-of-air path The upstream bend which curves so that it may turn being located in the upstream and inhalation-of-air applying [above-mentioned] it to the side from the engine upper part, It constitutes from a bay prolonged in the shape of a straight line succeeding the down-stream edge of this upstream bend, and a downstream bend which the above-mentioned upstream bend curves to an opposite direction succeeding the down-stream edge of this bay, and is open for free passage to a suction port. The suction system of the engine furthermore characterized by carrying out opening of the jet section of the above-mentioned addition gas on the wall surface corresponding to the inner circumference side of the above-mentioned upstream bend while carrying out opening of the nozzle hole of the above-mentioned injector moreover on the wall surface corresponding to the periphery side of the above-mentioned upstream bend of the above-mentioned upstream bend or a bay.

[Claim 5] While arranging an injector to the inhalation-of-air path which has a bend, it carries out as [supply / in this inhalation-of-air path / proper addition gas]. In the suction system of the engine which has arranged the closing motion valve open [to the upstream] furthermore and close the above-mentioned inhalation-of-air path alternatively according to engine operational status from this above-mentioned injector The deer of the direct down-stream location of the bend of the above-mentioned inhalation-of-air path or this bend also carries out opening of the nozzle hole of the above-mentioned injector on the wall surface by the side of the periphery of this bend. Moreover, while carrying out opening of the jet section of the above-mentioned addition gas on the wall surface by the side of the inner circumference of this bend While the above-mentioned closing motion valve carries out an arrangement setup near the upper edge of the above-mentioned bend in the condition of having turned in the direction which constitutes this from a butterfly valve and intersects perpendicularly the direction of a valve stem in the direction of a curve side of the above-mentioned bend The suction system of the engine characterized by setting up the valve-opening actuation direction so that it may be located in the inhalation-of-air downstream rather than the periphery section to which the periphery section located in the periphery side of the above-mentioned bend at the time of the valve opening is located in an inner circumference side.

[Claim 6] While arranging an injector to an inhalation-of-air path, it

carries out as [supply / in this inhalation-of-air path / proper addition gas]. In the suction system of the engine equipped with the closing motion valve open [from an injector] furthermore and close the above-mentioned inhalation-of-air path alternatively according to engine operational status to the upstream The upstream bend which curves so that it may turn being located in the upstream and inhalation-of-air applying [above-mentioned] it to the side from the engine upper part, While constituting from a bay prolonged in the shape of a straight line succeeding the down-stream edge of this upstream bend, and a downstream bend which the above-mentioned upstream bend curves to an opposite direction succeeding the down-stream edge of this bay, and is open for free passage to a suction port While carrying out opening of the nozzle hole of the above-mentioned injector on axial center extension of the above-mentioned bay Opening of the jet section of the above-mentioned addition gas is carried out on the inner circumference side-attachment-wall side of the above-mentioned upstream bend. Furthermore, while the above-mentioned closing motion valve carries out an arrangement setup near the upper edge of the above-mentioned bend in the condition of having turned in the direction which constitutes this from a butterfly valve and intersects perpendicularly the direction of a valve stem in the direction of a curve side of the above-mentioned bend The suction system of the engine characterized by setting up the valve-opening actuation direction so that it may be located in the inhalation-of-air downstream rather than the periphery section to which the periphery section located in the periphery side of the above-mentioned bend at the time of the valve opening is located in an inner circumference side. [Claim 7] The suction system of the engine characterized by having approached and installed the addition gas passageway which supplies the above-mentioned addition gas side by side in the above-mentioned assistant air passage in the suction system of an engine according to claim 1, 3.4, 5, or 6 so that assistant air could be supplied [both] through an assistant air passage near the nozzle hole of the above-mentioned injector then, and forming this assistant air passage and an addition gas passageway in it further as it straddled between [of each gas column] inhalation-of-air paths.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] The invention in this application relates to an engine suction system.
[0002]
[Description of the Prior Art] In the fuel-injection type engine equipped with the injector, since direct injection supply of the fuel is carried out into an inhalation-of-air path, if the quality of the evaporation / atomization engine performance is an engine combustion engine-performance total, it has great effect on the output engine performance. Therefore, the thought for the promotion of evaporation / atomization of an injection fuel is proposed variously conventionally, and there is thought of injecting the fuel from an injector also in an inhalation-of-air path to the part where the inhalation-of-air rate of flow is the quickest, making one of them promoting mixing with inhalation of air and a fuel, having, and aiming at improvement in its evaporation and atomization. And while forming an inhalation-of-air path in the shape of a curve as a means for embodying such thought so that a drawing indication may be carried out at JP,62-20624,A, for example, what was made to perform fuel injection into the quick inhalation-of-air style of the rate of flow which is made to carry out opening of the nozzle hole of an injector on the periphery side-attachment-wall side of this bend, and flows this periphery side-attachment-wall side approach is known.
[0003] In addition, generally, although it is known that the velocity distribution of flowing fluid (for example, inhalation of air) will be in the distribution condition that the high rate-of-flow region inclines toward the periphery approach, as [show / in drawing 5] about the inside of a curve path, this is based on the effect of the secondary flow resulting from the inertial force of an inhalation-of-air style. That is, the inhalation-of-air style A which flows the inside of the

curve path 51 is because of flowing in the shape of a straight line with the inertial force (if it puts in another way). In order to flow towards the peripheral-wall 51a side of the curve path 51, when this curve path 51 is seen from [the] a cross section, After flowing from inner circle wall 51b to the peripheral-wall 51a side along this flat surface in the both sides of the flat surface containing the medial axis of this curve path 51, respectively, it is reversed, and secondary flow A' which flows from the peripheral-wall 51a side to the inner circle wall 51b side along with the side peripheral walls 51c and 51c arises. When such a secondary flow arises in the curve path 51, the velocity distribution in the direction of an axial center which should serve as symmetry to a path axial center essentially will be made to deform by this secondary flow, and a velocity distribution by which the high rate-of-flow region inclined toward peripheral-wall 51a approach as shown in drawing 5 as a result will be presented.

[0004]

[Problem(s) to be Solved by the Invention] By the way, at the inhalation-of-air path with such a bend, the problem that mixing of this fuel will be promoted if a fuel is injected into this part, since the high rate-of-flow region inclines toward that periphery approach as mentioned above, and the charging efficiency of inhalation of air was checked by the bias of this velocity distribution on the other hand although it is the translation closed if that evaporation / atomization engine performance is good was pointed out from sometime past. That is, although the maximum rate of flow of inhalation of air becomes large when the high rate-of-flow region inclines toward the peripheral-wall 51a side greatly in the curve path 51 as mentioned above, the mean velocity becomes comparatively small. I hear that this cannot fully be utilizing thoroughly the effective sectional area of this curve path 51, and there is, consequently it becomes comparatively low [the charging efficiency of inhalation of air] considering the effective sectional area of the curve path 51.

[0005] In addition, if the mean velocity of inhalation of air tends to be raised and it is going to aim at improvement in the charging efficiency, although it is what is close to a straight line as much as possible, then a good translation, an inhalation-of-air path When it does in this way, while the mixing engine performance of a fuel falls by the fall of the maximum rate of flow, the present condition is an engine overall height's increasing, and there being a problem engine compactability's being checked, having carried out comparison ponderation of the above-mentioned advantages and disadvantages for this

reason, and having adopted the inhalation-of-air path of curve structure. Therefore, if an engine performance is considered from a total viewpoint, also although it is called the thing equipped with the inhalation-of-air path of metaphor curve structure, the decline in a charging efficiency must have been overlooked at all, and it will be going to think that the decline in a charging efficiency is an unescapable matter in the present condition, as long as the curved inhalation-of-air path structure is adopted, but to just wait for the solution means.

[0006] Then, in the suction system of the fuel-injection type engine equipped with the inhalation-of-air path with a bend, the invention in this application tends to attain improvement in the scavenging-air engine performance etc. to coincidence collectively, and is made while reconciling the promotion of evaporation / atomization of the fuel by the fuel injection to the high rate-of-flow inhalation of air, and improvement in the charging efficiency by high level maintenance of mean velocity.

[0007]

[Background of the Invention] In the process in which invention-in-this-application persons study this The means for solving a technical problem If the basic configuration of passing inhalation of air is adopted at all in a curve path, if not avoided the bias phenomenon by the side of the peripheral wall of the velocity distribution under the effect of a secondary flow Under recognition, The view was changed from the ED for improving the bias of a velocity distribution peculiar to a curve path itself, and it was presupposed to it that the technique for raising mean velocity is developed, maintaining excellently the maximum rate of flow brought about according to the bias of a velocity distribution without almost reducing this. And its attention was paid to the bias of the inhalation-of-air dynamic pressure which originates in the bias of a velocity distribution here, and the description of a secondary flow.

[0008] That is, as shown in the rate-of-flow distribution curve L1 of drawing 4 , the inhalation of air which flows the inside of the curve path 51 presents a velocity distribution by which the high rate-of-flow region inclines toward peripheral-wall 51a approach, but if this sees about inhalation-of-air dynamic pressure, it will attribute to the peripheral-wall 51a approach part of this curve path 51 having high dynamic pressure, and an inner circle wall 51b approach part having low dynamic pressure. Therefore, if the addition gas port 52 is formed in the inner circle wall 51b side with such low dynamic pressure and the addition gas G to inhalation of air, such as EGR gas, is supplied from here Suction installation of this addition gas G is carried out smoothly

in the near location of inner circle wall 51b with low dynamic pressure. And it is washed away by the introduced addition gas G at the downstream by the inhalation-of-air style which flows the inside of the curve path 51. Become suitable to be added to an original inhalation-of-air velocity distribution, and as the rate-of-flow distribution curve L2 shows, the high rate-of-flow region new into the inner circle wall approach part of the original inhalation-of-air rate-of-flow distribution curve will be formed in drawing 4 . The rate-of-flow distribution curve L2 turns into a "wen 2 Camel"-like curve which has the high rate-of-flow region in both a peripheral-wall approach part and an inner circle wall approach part as a whole (in the rate-of-flow distribution curve L2, the part shown by the broken-line arrow head is the rate of flow added by addition gas).

[0009] When inhalation of air and addition gas with the velocity distribution of the shape of such "2 A wen camel" flow to the downstream further, A velocity distribution is gradually equalized by the rate-of-flow part added by this addition gas by the secondary flow generated in the curve path 51 being gradually extruded from the inner circle wall 51b side at the peripheral-wall 51a side. As the rate-of-flow distribution curve L3 finally shows, the velocity distribution of the abbreviation trapezoidal shape by which the rate of flow itself was equalized in the condition that the maximum rate of flow hardly falls, i.e., the high velocity distribution of mean velocity, is acquired.

[0010] Invention-in-this-application persons hit on an idea in the technical thought for maintaining the maximum rate of flow and mean velocity excellently, both, having them based on such knowledge, by introducing addition gas into the inner circle wall side of a curve path, and attaining the inhalation-of-air charging efficiency according the mixing engine performance by the fuel injection to the high rate-of-flow region to improvement and high mean velocity to coincidence.

[0011]

[Means for Solving the Problem] As a concrete means for being based on this background technique and solving the above-mentioned technical problem in the invention in this application, in invention according to claim 1 In the suction system of the engine which supplied proper addition gas in this inhalation-of-air path while having arranged the injector to the inhalation-of-air path which has a bend The nozzle hole of the above-mentioned injector is characterized by the thing of the direct down-stream location of the bend of the above-mentioned inhalation-of-air path, or this bend done for opening of the jet section of the above-mentioned addition gas on the wall surface by the side of

the inner circumference of this bend, while carrying out opening on the wall surface by the side of the periphery of this bend moreover.
[0012] While arranging an injector in invention according to claim 2 to the inhalation-of-air path which has a bend In the suction system of the engine equipped with the closing motion valve open from this injector and close the above-mentioned inhalation-of-air path alternatively according to engine operational status to the upstream While carrying out opening of the nozzle hole of the above-mentioned injector on the wall surface by the side of the periphery of the above-mentioned bend While arranging the above-mentioned closing motion valve near the upper edge of the above-mentioned bend in the condition of having turned in the direction which constitutes this from a butterfly valve and intersects perpendicularly the direction of a valve stem in the direction of a curve side of the above-mentioned bend It is characterized by setting up the valve-opening actuation direction so that it may be located in the inhalation-of-air downstream rather than the periphery section to which the periphery section located in the periphery side of the above-mentioned bend at the time of the valve opening is located in an inner circumference side.
[0013] In invention according to claim 3, while arranging an injector to an inhalation-of-air path In the suction system of the engine which supplied proper addition gas in this inhalation-of-air path The upstream bend which curves so that it may turn being located in the upstream and inhalation-of-air applying [above-mentioned] it to the side from the engine upper part, The bay prolonged in the shape of a straight line to a slanting lower part succeeding the down-stream edge of this upstream bend, While constituting from a downstream bend which curves to an opposite direction and is open for free passage to a suction port with the above-mentioned upstream bend succeeding the down-stream edge of this bay and carrying out opening of the nozzle hole of the above-mentioned injector on axial center extension of the above-mentioned bay It is characterized by carrying out opening of the jet section of the above-mentioned addition gas on the inner circumference side-attachment-wall side of the above-mentioned upstream bend.
[0014] In invention according to claim 4, while arranging an injector to an inhalation-of-air path In the suction system of the engine which supplied proper addition gas in this inhalation-of-air path The upstream bend which curves so that it may turn being located in the upstream and inhalation-of-air applying [above-mentioned] it to the side from the engine upper part, It constitutes from a bay prolonged in the shape of a straight line succeeding the down-stream edge of this upstream bend, and

a downstream bend which the above-mentioned upstream bend curves to an opposite direction succeeding the down-stream edge of this bay, and is open for free passage to a suction port. Furthermore, while carrying out opening of the nozzle hole of the above-mentioned injector moreover on the wall surface corresponding to the periphery side of the above-mentioned upstream bend of the above-mentioned upstream bend or a bay, it is characterized by carrying out opening of the jet section of the above-mentioned addition gas on the wall surface corresponding to the inner circumference side of the above-mentioned upstream bend.

[0015] While arranging an injector in invention according to claim 5 to the inhalation-of-air path which has a bend In the suction system of the engine which has arranged the closing motion valve open [carries out as / supply / in this inhalation-of-air path / proper addition gas /, and / to the upstream] further and close the above-mentioned inhalation-of-air path alternatively according to engine operational status from this above-mentioned injector The deer of the direct down-stream location of the bend of the above-mentioned inhalation-of-air path or this bend also carries out opening of the nozzle hole of the above-mentioned injector on the wall surface by the side of the periphery of this bend. Moreover, while carrying out opening of the jet section of the above-mentioned addition gas on the wall surface by the side of the inner circumference of this bend While the above-mentioned closing motion valve carries out an arrangement setup near the upper edge of the above-mentioned bend in the condition of having turned in the direction which constitutes this from a butterfly valve and intersects perpendicularly the direction of a valve stem in the direction of a curve side of the above-mentioned bend It is characterized by setting up the valve-opening actuation direction so that it may be located in the inhalation-of-air downstream rather than the periphery section to which the periphery section located in the periphery side of the above-mentioned bend at the time of the valve opening is located in an inner circumference side.

[0016] In invention according to claim 6, while arranging an injector to an inhalation-of-air path In the suction system of the engine equipped with the closing motion valve open [carries out as / supply / in this inhalation-of-air path / proper addition gas /, and / from an injector] further and close the above-mentioned inhalation-of-air path alternatively according to engine operational status to the upstream The upstream bend which curves so that it may turn being located in the upstream and inhalation-of-air applying [above-mentioned] it to the side from the engine upper part, While constituting from a bay prolonged in the shape of a straight line succeeding the down-stream edge of this

upstream bend, and a downstream bend which the above-mentioned upstream bend curves to an opposite direction succeeding the down-stream edge of this bay, and is open for free passage to a suction port While carrying out opening of the nozzle hole of the above-mentioned injector on axial center extension of the above-mentioned bay Opening of the jet section of the above-mentioned addition gas is carried out on the inner circumference side-attachment-wall side of the above-mentioned upstream bend. Furthermore, while the above-mentioned closing motion valve carries out an arrangement setup near the upper edge of the above-mentioned bend in the condition of having turned in the direction which constitutes this from a butterfly valve and intersects perpendicularly the direction of a valve stem in the direction of a curve side of the above-mentioned bend It is characterized by setting up the valve-opening actuation direction so that it may be located in the inhalation-of-air downstream rather than the periphery section to which the periphery section located in the periphery side of the above-mentioned bend at the time of the valve opening is located in an inner circumference side.
[0017] In invention according to claim 7, in the suction system of an engine according to claim 1, 3.4, 5, or 6 so that assistant air can be supplied through an assistant air passage near the nozzle hole of the above-mentioned injector then both The addition gas passageway which supplies the above-mentioned addition gas is approached and installed in the above-mentioned assistant air passage side by side, and it is characterized by forming this assistant air passage and an addition gas passageway in it further, as it straddled between [of each gas column] inhalation-of-air paths.
[0018]
[Function] In this application each invention, the respectively following operations are acquired by considering as this configuration.
[0019] ** In invention according to claim 1, since, as for the inhalation-of-air style which flows the inside of an inhalation-of-air path with operation of an engine, this inhalation-of-air path has the bend, in this bend, the velocity distribution presents the velocity distribution by which the high rate-of-flow region inclined toward the wall surface approach part by the side of the periphery of this bend in response to the effect of the secondary flow by the inertial force of inhalation of air. Therefore, by performing fuel injection in such a high rate-of-flow region from an injector, mixing with this inhalation of air and a fuel becomes good, and evaporation and atomization of this fuel are promoted. Moreover, if a fuel is injected in the high rate-of-flow region in this way, it will also decrease that this fuel's fuel

adheres to a path wall surface since it rides in the style of [of the high rate of flow] inhalation of air and is smoothly carried to the downstream, and it will also become closed if the responsibility of the engine power to fuel supply is so good.
[0020] On the other hand, since the inner circumference side of a bend is the low rate of flow comparatively, while suction installation of this addition gas is smoothly carried out by the inhalation-of-air style which flows the inside of a bend by supplying addition gas from the jet section which that dynamic pressure prepared in the part where this dynamic pressure is low by being low, it will be added in the style of [this] inhalation of air in the condition of having been washed away in the style of [this] inhalation of air, and the rate of flow by the side of this inner circumference will be raised. And when the secondary flow which the addition gas which was introduced into this inner circumference side, and was added in the style of inhalation of air generates in a bend extrudes at a periphery side, the velocity distribution in this bend will be equalized and the mean velocity in this inhalation-of-air path will be raised by this.
[0021] Thus, when the mean velocity in an inhalation-of-air path is raised, this effect will reach from this to an upstream part, and the mean velocity in this upstream part will also be raised (if it puts in another way and a velocity distribution will be made to change). Inhalation-of-air installation will be efficiently performed within the limits of [larger] an inhalation-of-air path by improvement in such mean velocity (from the use effectiveness of the effective sectional area of an inhalation-of-air path improving, if it puts in another way), and the charging efficiency of inhalation of air is raised so much.
[0022] Furthermore, since addition gas is introduced into the inner circumference approach of a bend, when this bend is seen from a cross section, as mentioned above, the addition firedamp-migration operation by the secondary flow has a high addition gas consistency to the inner circumference side of a certain thing, and this is low at the periphery side. For this reason, when addition gas is gas of an elevated temperature [intake-air temperature] like EGR gas or blow-by gas, that inner circumference side of the temperature distribution of the gaseous mixture of the inhalation of air and addition gas in a bend is high, and a periphery side becomes low. Therefore, from the first, although the injection fuel from an injector has stopped easily being able to adhere to the inner circle wall side of a bend as mentioned above, considering the arrangement structure of this injector and it is also considered that the part arrives at an inner circle wall side too In this case,

even if a metaphor fuel reaches an inner circle wall side side, whenever [in this part / mixed atmospheric temperature] is comparatively high. And since this inner circle wall side itself is heated by addition gas and the wall temperature is high, most things that it is made to evaporate a fuel quickly here and it carries out an adhesion residual in this inner circle wall side are lost.

[0023] ** In invention according to claim 2, since opening of the nozzle hole of an injector is carried out to the periphery side of a bend, while the fuel from this injector will be injected by the maximum flow speed range in this bend, consequently it is closed if its mixing with this fuel and inhalation of air is good, and evaporation and atomization of this fuel are promoted, adhesion in the inner circle wall side of a fuel is also controlled as much as possible. In this case, since that valve-opening direction is set up as the periphery section of bend periphery approach is located in the inhalation-of-air downstream by the closing motion valve which consists of butterfly valves at the time of that valve opening, when the inhalation of air of the upstream passes a part for this closing motion valve portion from this closing motion valve, it shows around by this closing motion valve, and it will incline toward a bend periphery side and will flow. For this reason, the channeling operation by this closing motion valve brings a result further puffed up in the bias of the velocity distribution resulting from a secondary flow, the maximum rate of flow of the inhalation-of-air style in a bend is raised further, and the mixing operation of a fuel and inhalation of air by having arranged the nozzle hole of an injector to the periphery approach of a bend is promoted further.

[0024] Furthermore, also in the condition of having compared and having made this closing motion valve into the close by-pass bulb completely from the above-mentioned closing motion valve consisting of butterfly valves, inhalation of air will leak to the downstream of this closing motion valve through the very small clearance between the periphery edge of this closing motion valve, and a path wall. Moreover, as compared with the case where this closing motion valve is arranged near the down-stream edge of a bend like general before from this closing motion valve being arranged near the upper edge of a bend, for example, the distance between suction ports becomes long and the volume of a before [from this closing motion valve / a suction port] will increase from this closing motion valve so much. Therefore, the inspired air volume which leaks from a closing motion valve and collects in the volume between this closing motion valve and an inlet valve When it became more abundant as compared with structure conventionally, consequently valve

opening with an inlet valve and an exhaust valve overlaps in the end of life of an exhaust air process, While a lot of inhalation of air which had collected in this volume flows into a combustion chamber side and scavenges near [above-mentioned] the exhaust valve, it will be discharged from an exhaust air port, and scavenging is promoted only for a part with much residual inspired air volume in this volume.
[0025] ** While constituting an inhalation-of-air path from an upstream bend, a bay, and a downstream bend and arranging the nozzle hole of an injector into the periphery approach part of this upstream bend in invention according to claim 3 Although the same operation is acquired of course with having indicated to the above-mentioned ** about the inhalation-of-air style in this upstream bend part since opening of the jet section of addition gas is carried out to the inner circumference approach part, in addition to this, the still more nearly following operations are also acquired. That is, the above-mentioned bay follows the down-stream edge of an upstream bend, and is prolonged in the shape of a straight line to a slanting lower part, and a downstream bend follows the down-stream edge of this bay, and curves to an opposite direction with the above-mentioned upstream bend (if it puts in another way). Since it is curving so that it may go in the direction of an axial center of a combustion chamber, the mixed air current introduced into a combustion chamber from a downstream bend will generate the tumble flow which circles in the vertical direction in this combustion chamber through a bay from the above-mentioned upstream bend.
[0026] in this case, a this upstream bend part since the curve direction of the above-mentioned upstream bend and a downstream bend is reverse -- if it is, the addition gas located in that inner circumference side will be located in that periphery side in a downstream bend part. therefore, this addition gas from it being located in the periphery side of an inhalation-of-air style, and it being introduced into this combustion chamber with that condition, and becoming a tumble flow, when introduced into a combustion chamber from the above-mentioned bay In this combustion chamber, this addition gas reservoir will incline and exist in a part with comparatively low temperature called a combustion chamber wall surface or a piston-top surface, and inhalation of air will incline and exist inside this addition gas reservoir (namely, core side of a combustion chamber) as gaseous mixture of a thick condition comparatively.
[0027] Consequently, it will be closed, if the generating of an unburnt component since the part which tends to serve as [temperature] a generating part of an unburnt component low when fire retardancy gas,

such as EGR gas or blow-by gas, is used especially as addition gas, while the lamination in a combustion chamber was promoted and lean combustion was realized is covered by fire-resistant gas and penetration of the gaseous mixture to this part is controlled itself is controlled as much as possible and exhaust air emission is so good.
[0028] ** While invention according to claim 4 constitutes an inhalation-of-air path from an upstream bend, a bay, and a downstream bend and it carries out opening of the nozzle hole of an injector to the periphery side of an upstream bend Opening of the jet section of addition gas is carried out to the inner circumference side of this upstream bend, and it has composition which combined invention and invention according to claim 3 according to claim 1, therefore an operation given [above-mentioned] in ** and an operation given [above-mentioned] in ** can be attained to coincidence.
[0029] ** Invention according to claim 5 arranges a closing motion valve near the upper edge of this bend, and has composition which combined invention and invention according to claim 2 according to claim 1, therefore can attain the above-mentioned ** written operation and an operation given [above-mentioned] in ** to coincidence while the nozzle hole of an injector is turned on the periphery side of the bend of an inhalation-of-air path and it carries out opening of the jet section of addition gas to an inner circumference side, respectively.
[0030] ** While invention according to claim 6 constitutes an inhalation-of-air path from an upstream bend, a bay, and a downstream bend Turn the nozzle hole of an injector on the periphery side of this upstream bend, and opening of the jet section of addition gas is carried out to an inner circumference side, respectively. Furthermore, a closing motion valve is arranged near the upper edge of the above-mentioned upstream bend, and it has composition which combined invention and invention according to claim 3 according to claim 2, therefore an operation given [above-mentioned] in ** and an operation given [above-mentioned] in ** can be attained to coincidence.
[0031] ** While invention according to claim 7 prepares the assistant air passage which supplies the assistant air other than the addition gas passageway which supplies addition gas in invention according to claim 1, 3, 4, 5, or 6 Although an operation the above-mentioned **, **, **, **, or given in ** is acquired from the place which forms each [these] path between the inhalation-of-air paths of each gas column as straddles of course In addition to it, since between each inhalation-of-air path is connected in one by this addition gas passageway and the assistant air passage, such rigidity is raised.

[0032]
[Effect of the Invention] Therefore, according to the suction system of the engine of this application each invention, the respectively following effectiveness is acquired.
[0033] (a) According to the suction system of an engine according to claim 1 by carrying out opening of the nozzle hole of an injector to the periphery side of the bend of an inhalation-of-air path, turning a fuel to a maximum flow speed range, and carrying out injection supply, if in mixing of a fuel and inhalation of air, evaporation and atomization of a fuel can be promoted further in total -- both Adhesion in the inner circle wall side of a fuel can be prevented, and the responsibility of the engine power to fuel supply can be raised.
[0034] Furthermore, since installation of the addition gas by the side of the inner circumference of a bend is raising the mean velocity in an inhalation-of-air path, the use effectiveness of the effective sectional area of this inhalation-of-air path improves so much, and improvement in a charging efficiency can be aimed at as a result. That is, promotion of evaporation and atomization of the fuel by maintaining the maximum rate of flow highly and improvement in the charging efficiency by maintaining mean velocity highly can be attained to coincidence, having the inhalation-of-air path of curve structure.
[0035] (b) Since the bias of the velocity distribution of inhalation of air peculiar to an inhalation-of-air path with a bend is puffed up further and the maximum rate of flow is raised further, a channeling operation of the inhalation of air by the closing motion valve arranged near the upper edge of a bend is made to improve further rather than the case where evaporation and atomization of a fuel are the above-mentioned (a) publications according to the suction system of an engine according to claim 2.
[0036] Furthermore, while arranging the above-mentioned closing motion valve near the upper edge of a bend and making the volume between this closing motion valve and a suction port increase, the inhalation of air which leaks from the periphery of a closing motion valve in this volume is accumulated more in a large quantity, by the time of overlap of the valve-opening stage of an inlet valve and an exhaust valve, by a lot of inhalation of air, since he is trying to scavenge the exhaust air port circumference, that scavenging-air engine performance is high, and the increment in an inhalation-of-air fill can be aimed at so much.
[0037] (c) While according to the suction system of an engine according to claim 3 the effectiveness of the above-mentioned (a) publication is acquired, and also constituting an inhalation-of-air path from an

upstream bend, a bay, and a downstream bend and making a combustion chamber generate a tumble flow Since gaseous mixture is made for addition gas to exist in an inner circumference side in the shape of a layer, respectively and lamination of gaseous mixture is attained to the periphery side of this tumble flow, lean combustion becomes possible and improvement in the fuel consumption engine performance can be aimed at so much.

[0038] Moreover, since the penetration of the gaseous mixture to this part itself is prevented by making addition gas exist in the periphery section of a combustion chamber with comparatively low temperature, i.e., the generating part of an unburnt component, it is closed if generating of an unburnt component is ** as much as possible, and is effective in the ability to aim at an improvement of engine exhaust air emission so much.

[0039] (d) According to the suction system of an engine according to claim 4, the same effectiveness is attained by coincidence with having indicated to the above (a) and (c).

[0040] (e) According to the suction system of an engine according to claim 5, effectiveness the above (a) and given in (b) is attained by coincidence.

[0041] (f) According to the suction system of an engine according to claim 6, effectiveness the above (b) and given in (c) is attained by coincidence.

[0042] According to the suction system of an engine according to claim 7, (g) The above (a), In addition to effectiveness (c), (d), (e), or given in (f), each inhalation-of-air path corresponding to each gas column from having connected in one by the addition gas passageway and the assistant air passage The rigidity between each [these] inhalation-of-air path improves, the rigidity as the whole engine is raised, for example, the effectiveness that noise generating based on engine vibration can be reduced is acquired.

[0043]

[Example] If the suction system of the engine of the invention in this application is hereafter explained concretely based on the example shown in an accompanying drawing, one bank part of the 6-cylinder V-type engine for automobiles which equipped drawing 1 and drawing 2 with the inhalation of air concerning the example of the invention in this application is shown, and as for a cylinder-head cover and 6, in this drawing, the cam carrier with which a sign 1 supports a cylinder block and the cam shafts 23 and 24 of a Uichi Hidari pair [4 / the cylinder head, and / 3 and 4 / 2], and 5 are [a piston and 7] combustion

chambers. This engine is inhalation-of-air 2 valve and an exhaust air 2 valve type engine, suction ports 8 and 8 and the exhaust air ports 9 and 9 are formed in the inferior surface of tongue of the above-mentioned cylinder head 2 facing the above-mentioned combustion chamber 7, respectively, further, inlet valves 20 and 20 are arranged at each of these suction ports 8 and 8, and exhaust valves 21 and 21 are arranged at each exhaust air ports 9 and 9, respectively.
[0044] Furthermore, in this engine, it is made to connect with the surge tank 17 which has arranged the suction ports 8 and 8 of the above-mentioned pair in the upper part location of the above-mentioned cylinder-head cover 5 through the primary path 11 and the secondary path 12 which became independent, respectively, and the inhalation-of-air path 10 corresponding to one gas column consists of these two paths 11 and 12. Moreover, among these two paths 11 and 12, although the primary path 11 performs inhalation-of-air installation in all engine operating range, as for the secondary path 12, an engine load performs inhalation-of-air installation only in the heavy load field more than predetermined. And this primary path 11 and secondary path 12 The below-mentioned closing motion valve 18 is formed in the maximum upstream location (namely, outlet section 17a of the above-mentioned surge tank 17) of this secondary path 12, And since it is what has a configuration similarly except for the jet section 36 of the blow-by gas as addition gas being formed in the mid-position of this secondary path 12, Here, with reference to drawing 1 - drawing 3 , only the path configuration of the secondary path 12 is explained in full detail, and the explanation is omitted about the path configuration of the primary path 11.
[0045] The downstream bend 15 which curves towards the engine side gradually while the above-mentioned secondary path 12 follows the above-mentioned suction port 8 and the inside of the above-mentioned cylinder head 2 is gone up, The bay 14 in which turns the cylinder head 2 to the slanting upper part succeeding the upstream of this downstream bend 15, and is prolonged in the shape of a straight line, and the upper edge carries out opening to the side face of this cylinder head 2, It consists of upstream bends 13 of the upper edge of this bay 14, and outlet section 17a of the above-mentioned surge tank 17 to which the above-mentioned downstream bend 15 curves to hard flow so that the engine upper limit section may be involved in from the side, while straddling and being arranged free [attachment and detachment]. And the closing motion valve 18 which consists of butterfly valves is arranged at outlet section 17a of the above-mentioned surge tank 17 which is the maximum upstream location of this secondary path 12 in the

condition that you made it periphery section 18a located in the peripheral-wall 13a approach of this upstream bend 13 towards the direction which intersects perpendicularly with the curve side of the above-mentioned upstream bend 13 in that valve stem 19 located in the downstream rather than the above-mentioned valve stem 19.

[0046] In addition, the above-mentioned upstream bend 13 is mutually connected by the flanges 41 and 42 of a vertical pair among the inhalation-of-air paths 10 and 10 of each gas column, and constitutes one inlet manifold 30 while it is formed in one in the state of the upstream bend 22 (refer to drawing 2 and drawing 3) by the side of the above-mentioned primary path 11, and side-by-side installation, as shown in drawing 2 .

[0047] Furthermore, while the nozzle hole 26 near the down-stream edge of the above-mentioned upstream bend 13 which performs fuel installation into this upstream bend 13 is moreover formed in a peripheral-wall 13a approach part through the above-mentioned bay 14 at it as it directs in the above-mentioned suction port 8 as shown in drawing 1 and drawing 3 , the injector 25 is arranged at upper one end of this nozzle hole 26. In addition, such a nozzle hole 26 is similarly formed in the upstream bend 22 of the above-mentioned primary path 11, and the fuel injected from this injector 25 is supplied to the both sides by the side of the above-mentioned primary path 11 and the secondary path 12 through these two nozzle holes 26 and 26 at coincidence.

[0048] On the other hand, the above-mentioned inlet manifold 30 really forms the inhalation-of-air paths 10, 10, and 10 of each gas column in the outside location of inner circle wall 13b of the above-mentioned upstream bend 13 in the condition of having made the horizontal installation section 31 which installed the blow-by gas path 35 and the assistant air passage 37 in the interior side by side straddling a longitudinal direction, as shown in drawing 1 and drawing 2 . And opening of this blow-by gas path 35 is carried out on inner circle wall 13b of the upstream rather than the above-mentioned nozzle hole 26 through the jet section 36 which penetrated and formed inner circle wall 13b of the above-mentioned upstream bend 13. While the blow-by gas G (it corresponds to the addition gas in the range of an application for patent) introduced from a flueway 16 side is shunted toward each gas column side by this blow-by gas path 35 It is introduced, respectively in the jet sections 36 and 36 and the secondary path 12 of the gas column which corresponds from .. Furthermore, after the assistant air which the above-mentioned assistant air passage 37 was made open for free passage by the maximum upstream part of the above-mentioned nozzle

hole 26 through the free passage way 38 formed in the above-mentioned inlet manifold 30, and was supplied to this assistant air passage 37 is shunted toward each gas column side, respectively, it is supplied to the maximum upstream part of a nozzle hole 26 from the free passage way 38.
[0049] Then, actuation, effectiveness, etc. of a suction system which were constituted in this way are explained mainly taking the case of the flow by the side of the secondary path 12. If an engine is operated, since clausilium maintenance of the closing motion valve 18 will be first carried out in the low loading region, inhalation of air is introduced into a combustion chamber 7 only from the primary path 11 side, and a swirl style generates it in this combustion chamber 7. moreover, the gaseous mixture of the inhalation of air from the primary path 11 side since splitting supply of the fuel is carried out from an injector 25 in this case at both the primary path 11 and the secondary path 12, respectively, and a fuel -- moreover, from the secondary path 12 side, only a fuel is introduced, respectively. Furthermore, apart from this, the assistant air supplied to the assistant air passage 37 is supplied on the outskirts of a nozzle hole of an injector 25 through the free passage way 38, and promotion of mixing of a fuel and inhalation of air, and evaporation and atomization of a fuel are attained. Moreover, the blow-by gas supplied to the blow-by gas path 35 is introduced into upstream bend 13 part of the secondary path 12 from the jet section 36 (therefore, from this secondary path 12, the gaseous mixture of blow-by gas and a fuel will be strictly introduced to a combustion chamber 7).
[0050] On the other hand, if an engine load goes up and a heavy load operation region is arrived at, since the above-mentioned closing motion valve 18 opens, inhalation of air and the gaseous mixture of a fuel will be introduced into a combustion chamber 7 from the both sides of the primary path 11 and the secondary path 12, respectively. Moreover, apart from this, blow-by gas is introduced into upstream bend 13 part of the above-mentioned secondary path 12 from the jet section 36.
[0051] Here, the inhalation of air in the secondary path 12 which can be set in this case, the flow of blow-by gas, a mixing operation of a fuel, etc. are explained, respectively. First, although it is the flow of inhalation of air, after inhalation of air flows into the secondary path 12 side through the closing motion valve 18 from a surge tank 17, it results [from the upstream bend 13] the inside of this secondary path 12 in the downstream bend 15 through a bay 14, and, finally is inhaled in a combustion chamber 7 from a suction port 8. In this case, since the above-mentioned upstream bend 13 is curving greatly, it will be in the condition that the maximum rate of flow inclined toward the peripheral-

wall 13a side as the rate-of-flow distribution curve L1 in drawing 4 showed the velocity distribution in this upstream bend 13 by the secondary flow resulting from the inertial force of an inhalation-of-air style. And the bias of this velocity distribution becomes the most remarkable at the time of valve opening of the closing motion valve 18. That is, since periphery marginal 18a of that bend periphery approach carries out valve-opening actuation as this closing motion valve 18 is located in the inhalation-of-air downstream, in case the inhalation of air from the above-mentioned surge tank 17 passes this closing motion valve 18, it is for receiving the operation which carries out channeling to bend periphery approach by this closing motion valve 18. Therefore, the in this case highest maximum rate of flow is attained.

[0052] And the above-mentioned velocity distribution since the jet section 36 is formed on that inner circle wall side 13b in this example in the middle of the path of this upstream bend 13 although it continues as it is while, as for such a partial velocity distribution, inhalation of air will circulate the inside of the upstream bend 13, if it is structure conventionally, and he is trying to make here to blow-by gas introduce in the upstream bend 13 changes gradually with flowing down of inhalation of air.

[0053] That is, it has a velocity distribution as shown by the rate-of-flow distribution curve L1 of drawing 4 in the upstream from the jet section 36, therefore the dynamic pressure according to the inhalation-of-air style A near the inner circle wall side 13b of the upstream bend 13 is low, and blow-by gas G is smoothly introduced in the upstream bend 13 from here. The blow-by gas G introduced near this inner circle wall side 13b Become the appearance added in the style of [A] inhalation of air when being washed away as it is by this by the inhalation-of-air style in this upstream bend 13 at the downstream, and it sets to the direct downstream of the jet section 36 as a result. As the rate-of-flow distribution curve L2 of drawing 4 shows, it becomes the velocity distribution of the shape of "2 A wen camel" which had the high rate-of-flow region, respectively in both the periphery wall surface 13a approach location and the inner circle wall side 13b approach location.

[0054] However, the velocity distribution of the shape of such "2 A wen camel" is not what is maintained forever as it is. In response to the effect of a secondary flow, the high rate-of-flow region of inner circle wall side 13b approach is gradually extruded at the periphery wall surface 13a side with flowing down of inhalation of air. The velocity distribution of the abbreviation trapezoidal shape which does not have so big the rate-of-flow difference in periphery wall surface 13a

approach and inner circle wall side 13b approach as the rate-of-flow distribution curve L3 of drawing 4 shows will be presented. Therefore, in the condition of having become such a velocity distribution, while there is almost no change in the maximum rate of flow in a periphery wall surface 13a approach location, the mean velocity in the upstream bend 13 will go up sharply. Thus, it is what (if it puts in another way, the use effectiveness of effective sectional area will increase) the cross section which can contribute effective in inhalation-of-air installation among the upstream bends 13 increases that mean velocity goes up, and it can perform inhalation-of-air installation so so much at high speed, and leads to the improvement in the charging efficiency of inhalation of air, as a result improvement in the output engine performance as a result. In addition, if the velocity distribution in the downstream of the jet section 36 of blow-by gas is improved in this way, this effect of not remaining only in the downstream, but also attaining to the upstream rather than this jet section 36, and the velocity distribution of that part also being improved from it, is natural.

[0055] In addition, the high rate-of-flow region of the inner circle wall side 13b approach attained by addition of blow-by gas Since it moves to the periphery wall surface 13a side gradually according to flowing down of inhalation of air, it becomes the velocity distribution from which the highest mean velocity as shown to some extent by the rate-of-flow distribution curve L3 of drawing 4 in a down-stream approach location from the formation location of the jet section 36 of blow-by gas is obtained. The bias by the side of periphery wall surface 13a of a velocity distribution becomes remarkable again as it goes down down-stream further from it, and it becomes the velocity distribution which only the maximum rate of flow finally projected, and will be in the condition which is not desirable from the point of a charging efficiency. For this reason, in this example, while setting up the down-stream end position of the upstream bend 13 near the location where the velocity distribution like the rate-of-flow distribution curve L3 of drawing 4 is acquired, it is made to carry out opening of the nozzle hole 26 of the above-mentioned injector 25 to this part.

[0056] On the other hand, the injection fuel from an injector 25 From this being supplied towards the direction of an axial center of a bay 14 from the nozzle hole 26 of the location where the velocity distribution like the above-mentioned rate-of-flow distribution curve L3 is acquired which moreover carried out opening to periphery wall surface 13a approach This fuel rides on the inhalation of air of the largest part of

the rate of flow, since mixing with this inhalation of air is promoted, if its evaporation / atomization condition of this fuel is as much as possible good, it is closed, as a result it can be contributed to the improvement of engine inflammable ability.

[0057] Moreover, although this blow-by gas is made to move to the periphery wall surface 13a side gradually with installation into the upstream bend 13 by the secondary flow when the flow of blow-by gas is seen, it means that this does not say that blow-by gas moves to the periphery wall surface 13a side on the whole, but it moves, mixing with inhalation of air gradually, and there is. Therefore, if it sees from the whole flow in the secondary path 12, its inner circle wall side 13b approach side is still high until the density distribution in the secondary path 12 of the blow-by gas G introduced into the inner circle wall side 13b approach of the upstream bend 13 reaches the down-stream edge (namely, suction port 8), and the periphery wall surface 13a approach side is low. For this reason, the inner circle wall side 13b approach part of this upstream bend 13 is high, and the intake-air temperature (strictly gaseous mixture of inhalation of air and blow-by gas temperature) applied to a bay 14 near the down-stream edge of the upstream bend 13 is the same also about a wall temperature.

[0058] Therefore, the fuel injected in the upstream bend 13 from the nozzle hole 26 Ride in the style of [of the high rate of flow] inhalation of air, and it is carried to a combustion chamber 7 side, and in a thing side and the above-mentioned inner circle wall side 13a side from that temperature (a wall temperature and both sides of ambient temperature) being high, and evaporation / atomization nature of the fuel in this part being good Fuel adhesion on the wall surface by the side of this inner circle wall side 13b (the wall surface of a bay 14 and the downstream bend 15 is also included) is prevented as much as possible, as a result the responsibility of the engine power to fuel control is improved.

[0059] Furthermore, although inhalation of air flows the periphery wall surface 13a approach part of the upstream bend 13 and blow-by gas mainly flows inner circle wall side 13b approach as mentioned above in the secondary path 12 In this case, while a bay 14 directs in a suction-port 8 side with a quite big inclination like this example If the downstream bend 15 following this is turned in the direction of an axial center of a combustion chamber 7 and is incurvated, the gaseous mixture inhaled in a combustion chamber 7 from a suction port 8 will generate the so-called tumble flow which circles in the vertical direction in this combustion chamber 7. by the way, in the thing of this example, the blow-by gas G

which mainly existed in the inner circle wall side 13b approach of the upstream bend 13 as mentioned above from flowing in a combustion chamber 7 along with the wall surface of the bay 14 located in this inner circle wall side 13b side as it is, and the wall surface of the downstream bend 15 the inside of this combustion chamber 7 -- setting -- blow-by gas G -- the side near the wall of this combustion chamber 7, or the top face of a piston 6 -- the shape of a layer -- existing -- inhalation of air and the gaseous mixture of a fuel -- B will exist in the condition of having been wrapped in inside this blow-by gas layer. That is, the lamination in a combustion chamber 7 is attained.

[0060] Therefore, although it is natural that the ** ratio engine performance is made to improve by implementation of the lean combustion by lamination of gaseous mixture, in addition to this, an improvement of exhaust air emission and the knocking engine performance is also further achieved by coincidence. namely, combustion of an in [since the periphery section of a combustion chamber 7, i.e., the part which an unburnt component tends to generate badly / temperature is comparatively low and / combustion /, is occupied in this way by nonflammable gas called blow-by gas, there is no inflow of the gaseous mixture to this part, therefore / this part] naturally -- ********** -- as a result, the generating of an unburnt component itself is controlled as much as possible, and it leads to an improvement of exhaust air emission. Moreover, since the end gas zone used as the remote cause of knocking generating itself disappears, knocking generating is prevented as much as possible, as a result that the periphery section of a combustion chamber 7 is occupied by blow-by gas in this way can also expect an improvement of the output engine performance by raise in a compression ratio.

[0061] Furthermore, although clausilium maintenance of the above-mentioned closing motion valve 18 is carried out in an engine low loading field, even if it compares and this suits a close-by-pass-bulb-completely condition from this closing motion valve 18 consisting of butterfly valves, a very small clearance is formed between that periphery section and path wall. Therefore, small quantity [every] inhalation of air will leak and appear from this clearance in a suction-port 8 side in the clausilium condition of the closing motion valve 18. The inspired air volume which the volume between this closing motion valve 18 and an inlet valve 20 is quite large, comparing with structure conventionally since this is arranged near the upstream edge of the upstream bend 13 in this example on the other hand, although this closing motion valve 18 is arranged in the location conventionally near

a suction port 8 generally, therefore collects in the volume of the leakage lever from the clearance between the above-mentioned closing motion valves 18 also increases sharply. Thus, when a lot of inhalation of air has collected in the above-mentioned volume, when valve opening of an inlet valve 20 and an exhaust valve 21 overlaps in the end of life like an exhaust air line, a lot of inhalation of air will flow in a combustion chamber 7 from a suction port 8, and this inflow inhalation of air will scavenge the exhaust air port 9 circumference efficiently.
[0062] Moreover, since it is supplied near the nozzle hole of an injector 25 after the assistant air in the assistant this air passage 37 since the blow-by gas path 35 and the assistant air passage 37 are installed in the state of contiguity in the horizontal installation section 31 is warmed by the heat of blow-by gas, a promotion operation of evaporation and atomization of the fuel by this assistant air will be raised further. moreover, the horizontal installation section 31 in which this blow-by gas path 35 and the assistant air passage 37 were formed -- each inhalation-of-air paths 10 and 10 of an inlet manifold 30, and .. as for this inlet manifold 30, those vertical both ends are connected by flanges 41 and 42, respectively by forming between in the condition of having straddled in the direction of arrangement of cylinders -- in addition, since that pars intermedia is also connected by this horizontal installation section 31, that rigidity is made to improve And the rigidity as the whole engine is raised by the rigid rise of this inlet manifold 30, and noise generating by engine vibration is also reduced as much as possible.
[0063] In addition, in the above-mentioned example, although he is trying to introduce blow-by gas as addition gas, the invention in this application is not limited to this, and can be changed into this blow-by gas, for example, can also adopt EGR gas as addition gas.
[0064] Moreover, in this example, although the jet section 36 of addition gas is formed in the secondary path 12 side, the invention in this application is not limited to this, and can also form this in the primary path 11 side.

[Translation done.]

DESCRIPTION OF DRAWINGS

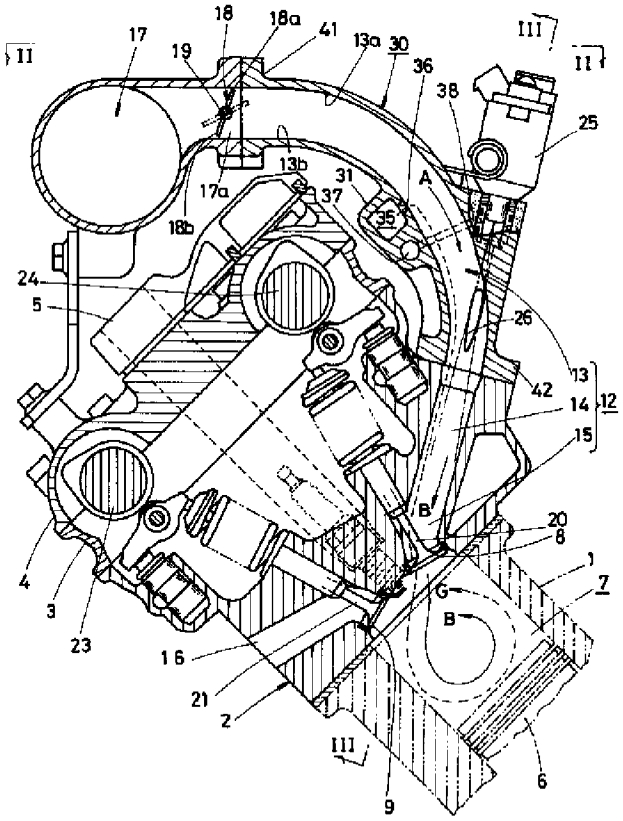
[Brief Description of the Drawings]
[Drawing 1] It is the important section sectional view of the engine equipped with the suction system concerning the example of the invention in this application.
[Drawing 2] It is the II-II view Fig. of drawing 1 .
[Drawing 3] It is III-III drawing of longitudinal section of drawing 1 .
[Drawing 4] It is the velocity-distribution explanatory view of the inhalation of air in an inhalation-of-air path.
[Drawing 5] It is the velocity-distribution explanatory view of the inhalation of air in an inhalation-of-air path.
[Description of Notations]
In 1, a cylinder block and 2 a cam carrier and 4 for the cylinder head and 3 A cam carrier, In a cylinder-head cover and 6, a piston and 7 a suction port and 9 for a combustion chamber and 8 An exhaust air port, [5] 10 a primary path and 12 for an inhalation-of-air path and 11 A secondary path, In 13, an upstream bend and 14 a downstream bend and 16 for a bay and 15 A flueway, In a surge tank and 18, a closing motion valve and 19 an inlet valve and 21 for a valve stem and 20 An exhaust valve, [17] 23 -- a cam shaft and 24 -- a cam shaft and 25 -- for an inlet manifold and 31, as for a blow-by gas path and 36, the horizontal installation section and 35 are [an injector and 26 / a nozzle hole and 30 / the jet section and 37] assistant air passages.

[Translation done.]

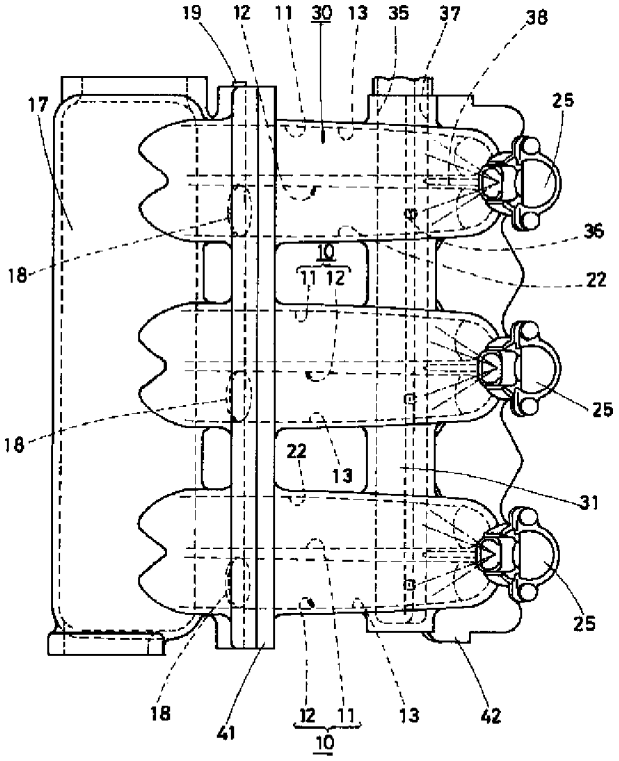
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

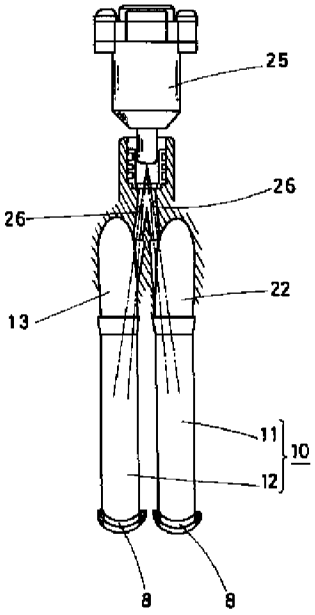
[Drawing 1]



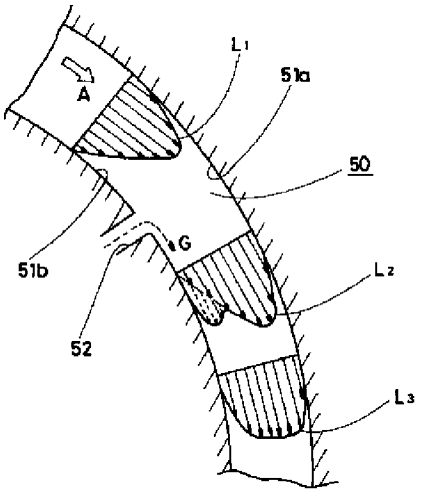
[Drawing 2]



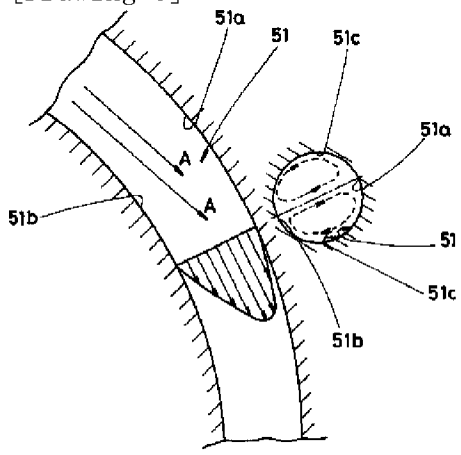
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)特　許　公　報（Ｂ２）　(11)特許番号
特許第3071260号
(P3071260)

(45)発行日　平成12年７月31日(2000.7.31)　(24)登録日　平成12年５月26日(2000.5.26)

(51)Int.Cl.[7]	識別記号	ＦＩ	
Ｆ０２Ｍ　69/00		Ｆ０２Ｍ　69/00	３５０Ｐ
	３１０		３１０Ａ
25/07	５８０	25/07	５８０Ｂ
29/00		29/00	Ｃ
			Ｄ

請求項の数３(全　８　頁)　最終頁に続く

(21)出願番号　特願平3－247219

(22)出願日　平成３年９月26日(1991.9.26)

(65)公開番号　特開平5－87024

(43)公開日　平成５年４月６日(1993.4.6)

審査請求日　平成10年７月27日(1998.7.27)

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(54)【発明の名称】　エンジンの吸気装置

(57)【特許請求の範囲】

【請求項１】　湾曲部を有する吸気通路にインジェクターを配置するとともに、該インジェクターより上流側にエンジンの運転状態に応じて上記吸気通路を選択的に開閉する開閉弁を備えたエンジンの吸気装置において、上記インジェクターの噴孔を上記湾曲部の外周側の壁面上に開口させる一方、上記開閉弁はこれをバタフライ弁で構成し且つその弁軸方向を上記湾曲部の湾曲面方向に直交する方向に向けた状態で上記湾曲部の上流側に配置するとともに、その開弁時においては上記湾曲部の外周側に位置する周縁部が内周側に位置する周縁部よりも吸気下流側に位置するように開弁作動方向を設定したことを特徴とするエンジンの吸気装置。

【請求項２】　請求項１記載のエンジンの吸気装置において、上記吸気通路内に適宜の付加ガスを供給し得るように、該付加ガスの噴出部を上記湾曲部の内周側の壁面上に開口させたことを特徴とするエンジンの吸気装置。

【請求項３】　請求項２記載のエンジンの吸気装置において、上記インジェクターの噴孔近傍にアシストエア通路を介してアシストエアを供給し得る如くするとともに、上記付加ガスを供給する付加ガス通路を上記アシストエア通路に近接して並設し、さらに該アシストエア通路と付加ガス通路とを各気筒の吸気通路相互間に跨がるようにして形成したことを特徴とするエンジンの吸気装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本願発明は、エンジンの吸気装置に関するものである。

【０００２】

3

【従来の技術】インジェクターを備えた燃料噴射式エンジンにおいては、燃料が吸気通路内に直接噴射供給されることからその気化・霧化性能の良否がエンジンの燃焼性能延いては出力性能に多大な影響を及ぼす。従って、従来より噴射燃料の気化・霧化促進のための思想が種々提案されており、その一つに、インジェクターからの燃料を吸気通路内でも最も吸気流速が速い部位に噴射して吸気と燃料とのミキシングを促進させもってその気化・霧化の向上を図るという思想がある。そして、このような思想を具現化するための手段としては、例えば特開昭６２－２０６２４号公報に図面開示されるように、吸気通路を湾曲状に形成するとともに、インジェクターの噴孔を該湾曲部の外周側壁面上に開口させて該外周側壁面寄りを流れる流速の速い吸気流中に燃料噴射を行うようにしたものが知られている。

【０００３】尚、一般に湾曲通路内を流れる流体(例えば、吸気)の流速分布は図５に示すように、その外周寄りに高流速域が偏るような分布状態となることが知られているが、これは吸気流の慣性力に起因する二次流れの影響によるものである。即ち、湾曲通路５１内を流れる吸気流Ａはその慣性力により直線状に流れようとするため(換言すれば、湾曲通路５１の外周壁５１ａ側に向けて流れようとするため)、該湾曲通路５１をその断面方向から見た場合、該湾曲通路５１の中心軸を含む平面の両側においてそれぞれ該平面に沿って内周壁５１ｂから外周壁５１ａ側に流れたのち反転し、側周壁５１ｃ,５１ｃに沿って外周壁５１ａ側から内周壁５１ｂ側に流れる二次流れＡ′が生じる。このような二次流れが湾曲通路５１内に生じると、本来通路軸心に対して対称となるべき軸心方向における流速分布が該二次流れによって変形せしめられ、結果的に図５に示すように外周壁５１ａ寄りに高流速域が偏ったような流速分布を呈することとなるものである。

【０００４】

【発明が解決しようとする課題】ところで、このような湾曲部をもつ吸気通路においては、上述のようにその外周寄りに高流速域が偏るためこの部分に燃料を噴射すれば該燃料のミキシングが促進される傾向にあるが、さらに燃料の気化・霧化性能の向上が望まれる。さらには、高流速域が外周壁５１ａ側に大きく偏った場合には、吸気の最大流速は大きくなるものの、その平均流速は比較的小さくなる。このことは、該湾曲通路５１の有効断面積を十分に生かしきれていないということであり、この結果、湾曲通路５１の有効断面積の割りには吸気の充填効率が比較的低劣となるものである。

【０００５】尚、吸気の平均流速を高めてその充填効率の向上を図ろうとすれば吸気通路をできるだけ直線に近いものとすれば良い訳であるが、このようにした場合に、最大流速の低下によって燃料のミキシング性能が低下するとともに、エンジン全高が増加しエンジンのコンパクト性が阻害されるという問題があり、このため上記の得失を比較考量して湾曲構造の吸気通路を採用しているのが現状である。従って、現状では湾曲した吸気通路構造を採用する限り、充填効率の低下は不可避な事項であると考えられているが、エンジン性能をトータル的観点から考察すれば、例え湾曲構造の吸気通路を備えたものと言えども充填効率の低下は到底看過し得ないものであり、その解決手段が待たれるところである。

4

【０００６】そこで本願発明は、湾曲部をもつ吸気通路を備えた燃料噴射式エンジンの吸気装置において、さらに高流速域の吸気流速を高めて、この高流速域への燃料噴射による燃料の気化・霧化促進を助長させるものであり、また、平均流速の高水準維持による充填効率の向上と燃料の気化・霧化促進とを両立させるものである。

【０００７】

【発明の技術的背景】本願発明者らは、かかる課題を解決するための手段を研究する過程において、湾曲通路内に吸気を流すという基本構成を採用する以上、二次流れの影響による流速分布の外周壁側への偏り現象は避けられないとの認識の下、湾曲通路に特有の流速分布の偏りそのものを改善するための技術開発から視点を変えて、流速分布の偏りによってもたらされる最大流速はこれをほとんど低下させることなく高水準に維持しつつ平均流速を高めるための技術を開発することとした。そして、ここで流速分布の偏りに起因する吸気動圧の偏り及び二次流れの性状に着目した。

【０００８】即ち、図４の流速分布曲線L_1に示すように湾曲通路５１内を流れる吸気は高流速域が外周壁５１ａ寄りに偏るような流速分布を呈するが、このことは吸気動圧についてみれば、該湾曲通路５１の外周壁５１ａ寄り部分は動圧が高く、内周壁５１ｂ寄り部分は動圧が低いということに帰する。従って、このような動圧の低い内周壁５１ｂ側に付加ガス噴出口５２を形成し、ここからＥＧＲガス等の吸気に対する付加ガスＧを供給してやれば、該付加ガスＧは動圧が低い内周壁５１ｂの近傍位置へスムーズに吸引導入され、且つ導入された付加ガスＧは湾曲通路５１内を流れる吸気流によって下流側に押し流されて、本来の吸気流速分布に付加される格好となり、図４に流速分布曲線L_2で示すように本来の吸気流速分布曲線の内周壁寄り部分に新たな高流速域を形成することとなり、全体として流速分布曲線L_2は外周壁寄り部分と内周壁寄り部分の両方に高流速域をもつ“二こぶラクダ”状曲線となる(流速分布曲線L_2において、破線矢印で示した部分が付加ガスにより付加された流速である)。

【０００９】このような“二こぶラクダ”状の流速分布をもつ吸気と付加ガスとがさらに下流側に流れる場合、湾曲通路５１内に発生する二次流れによってこの付加ガスによって付加された流速部分が次第に内周壁５１ｂ側から外周壁５１ａ側に押し出されることで次第に流速分

布が平均化され、最終的に流速分布曲線Ｌ₃で示すように最大流速はほとんど低下しない状態で流速そのものが平均化された略台形状の流速分布、即ち平均流速の高い流速分布が得られるものである。

【００１０】本願発明者らは、このような知見に基づき、インジェクターより上流側に吸気通路を選択的に開閉するバタフライ弁を設け、このバタフライ弁を開弁時においては湾曲部の外周側に位置する周縁部が内周側に位置する周縁部よりも吸気下流側に位置するように開弁作動方向を設定することで、湾曲部外周寄りの吸気流速がさらに高められ、この高流速域への燃料噴射によるミキシング性能を高水準に高めることができること、さらには、湾曲通路の内周壁側に付加ガスを導入することで最大流速と平均流速とをともに高水準に維持し、高い平均流速による高い吸気充填効率が得られることに想到したものである。

【００１１】

【課題を解決するための手段】かかる背景技術に立脚し、本願発明では上記課題を解決するための具体的手段として、請求項１記載の発明では、湾曲部を有する吸気通路にインジェクターを配置するとともに、該インジェクターより上流側にエンジンの運転状態に応じて上記吸気通路を選択的に開閉する開閉弁を備えたエンジンの吸気装置において、上記インジェクターの噴孔を上記湾曲部の外周側の壁面上に開口させる一方、上記開閉弁はこれをバタフライ弁で構成し且つその弁軸方向を上記湾曲部の湾曲面方向に直交する方向に向けた状態で上記湾曲部の上流側に配置するとともに、その開弁時においては上記湾曲部の外周側に位置する周縁部が内周側に位置する周縁部よりも吸気下流側に位置するように開弁作動方向を設定したことを特徴としている。

【００１２】請求項２記載の発明では、請求項１記載のエンジンの吸気装置において、上記吸気通路内に適宜の付加ガスを供給し得るように、該付加ガスの噴出部を上記湾曲部の内周側の壁面上に開口させたことを特徴としている。

【００１３】請求項３記載の発明では、請求項２記載のエンジンの吸気装置において、上記インジェクターの噴孔近傍にアシストエア通路を介してアシストエアを供給し得る如くするとともに、上記付加ガスを供給する付加ガス通路を上記アシストエア通路に近接して並設し、さらに該アシストエア通路と付加ガス通路とを各気筒の吸気通路相互間に跨がるようにして形成したことを特徴としている。

【００１４】

【００１５】

【００１６】

【００１７】

【００１８】

【作用】本願各発明ではかかる構成とすることによって

それぞれ次のような作用が得られる。

【００１９】１　請求項１記載の発明では、エンジンの運転に伴って吸気通路内を流れる吸気流は、該吸気通路が湾曲部を有していることから、該湾曲部においては吸気の慣性力による二次流れの影響を受けてその流速分布は該湾曲部の外周側の壁面寄り部分に高流速域が偏った流速分布を呈し、さらに、バタフライ弁で構成される開閉弁が、その開弁時には湾曲部外周寄りの周縁部が吸気下流側に位置するようにしてその開弁方向が設定されていることから、該開閉弁より上流側の吸気は該開閉弁部分を通過する時に該開閉弁によって案内されて湾曲部外周側に偏って流れることとなる。このため、この開閉弁による偏流作用が、二次流れに起因する流速分布の偏りをさらに増長する結果となり、湾曲部内の吸気流の最大流速がさらに高められる結果、このような高流速域にインジェクターから燃料噴射が行なわれることにより、該吸気と燃料とのミキシング作用が大きく向上し、該燃料の気化・霧化が促進されるものである。

【００２０】

【００２１】

【００２２】

【００２３】２　請求項２記載の発明では、上記請求項１記載の作用に加え、湾曲部の内周側はより低流速であることからその動圧が低くなっており、この動圧の低い部位に設けた噴出部から付加ガスを供給することにより、該付加ガスは湾曲部内を流れる吸気流によってスムーズに吸引導入されるとともに、該吸気流に押し流された状態で該吸気流に付加され、該内周側の流速が高められることとなる。そして、この内周側に導入され且つ吸気流に付加された付加ガスが湾曲部内に発生する二次流れによって外周側に押し出されることにより、該湾曲部内における流速分布が平均化され、これにより該吸気通路内における平均流速が高められ、吸気通路のより広い範囲内において効率良く吸気導入が行なわれることとなり(換言すれば、吸気通路の有効断面積の利用効率が向上することから)、それだけ吸気の充填効率が高められるものである。

【００２４】

【００２５】３　請求項３記載の発明では、請求項２記載の発明において、付加ガスを供給する付加ガス通路の他に、アシストエアを供給するアシストエア通路を設けるとともに、これら各通路を各気筒の吸気通路間に跨がるようにして形成したものであるところから、上記請求項２記載の作用が得られることは勿論であるが、それに加えて、該付加ガス通路とアシストエア通路とで各吸気通路間が一体的に連結されることからこれらの剛性が高められるものである。

【００２６】

【００２７】

【００２８】

【００２９】
【００３０】
【００３１】
【００３２】
【発明の効果】従って、本願各発明のエンジンの吸気装置によればそれぞれ次のような効果が得られる。
【００３３】
【００３４】
【００３５】(ａ) 請求項１記載のエンジンの吸気装置によれば、湾曲部の上流端近傍に配置した開閉弁による吸気の偏流作用によって、湾曲部をもつ吸気通路に特有の吸気の流速分布の偏りをさらに増長させて最大流速をより一層高めることから、燃料の気化・霧化が充分に向上せしめられるものである。
【００３６】
【００３７】
【００３８】
【００３９】
【００４０】(ｂ) 請求項２記載のエンジンの吸気装置によれば、上記(a)記載の効果に加えて、湾曲部の内周側への付加ガスの導入によって吸気通路内の平均流速を高めているため、それだけ該吸気通路の有効断面積の利用効率が向上し、結果的に充填効率の向上が図れるものである。即ち、湾曲構造の吸気通路を備えたものでありながら、最大流速を高く維持することによる燃料の気化・霧化の促進と、平均流速を高く維持することによる充填効率の向上とを同時に達成することができるものである。
【００４１】
【００４２】(ｃ) 請求項３記載のエンジンの吸気装置によれば、上記(ａ),(ｂ)記載の効果に加えて、各気筒に対応する各吸気通路を付加ガス通路とアシストエア通路とによって一体的に連結していることから、これら各吸気通路相互間の剛性が向上し、延いてはエンジン全体としての剛性を高めて、例えばエンジン振動に基づく騒音発生を低減できるという効果が得られるものである。
【００４３】
【実施例】以下、添付図面に示す実施例に基づいて本願発明のエンジンの吸気装置を具体的に説明すると図１及び図２には本願発明の実施例にかかる吸気を備えた自動車用６気筒Ｖ型エンジンの一方のバンク部分が示されており、同図において符号１はシリンダブロック、２はシリンダヘッド、３および４は左右一対のカムシャフト２３,２４を支承するカムキャリア、５はヘッドカバー、６はピストン、７は燃焼室である。このエンジンは、吸気２弁・排気２弁式エンジンであって、上記燃焼室７に臨む上記シリンダヘッド２の下面には吸気ポート８,８と排気ポート９,９がそれぞれ形成され、さらにこの各吸気ポート８,８にはそれぞれ吸気弁２０,２０が、また各排気ポート９,９にはそれぞれ排気弁２１,２１が配置されている。
【００４４】さらに、このエンジンにおいては、上記一対の吸気ポート８,８を、それぞれ独立したプライマリー通路１１とセカンダリー通路１２を介して上記ヘッドカバー５の上方位置に配置したサージタンク１７に接続させており、この二つの通路１１,１２で一つの気筒に対応する吸気通路１０を構成している。また、この二つの通路１１,１２のうち、プライマリー通路１１はエンジンの全運転領域において吸気導入を行うが、セカンダリー通路１２はエンジン負荷が所定以上の高負荷領域においてのみ吸気導入を行う。そして、このプライマリー通路１１とセカンダリー通路１２は、該セカンダリー通路１２の最上流位置(即ち、上記サージタンク１７の出口部１７a)に後述の開閉弁１８が設けられていること、及び該セカンダリー通路１２の中間位置に付加ガスとしてのブローバイガスの噴出部３６が形成されていることを除いて同様構成をもつものであるため、ここでは図１～図３を参照してセカンダリー通路１２の通路構成のみを詳述し、プライマリー通路１１の通路構成についてはその説明を省略する。
【００４５】上記セカンダリー通路１２は、上記吸気ポート８に連続して上記シリンダヘッド２内を上方に向かいながら次第にエンジン側方に向けて湾曲する下流側湾曲部１５と、該下流側湾曲部１５の上流側に連続してシリンダヘッド２を斜め上方に向けて直線状に延び且つその上流端が該シリンダヘッド２の側面に開口する直線部１４と、該直線部１４の上流端と上記サージタンク１７の出口部１７aとの跨って着脱自在に配置されるとともにエンジン上端部をその側方から巻き込むように上記下流側湾曲部１５とは逆方向に湾曲する上流側湾曲部１３とで構成されている。そして、このセカンダリー通路１２の最上流位置である上記サージタンク１７の出口部１７aには、バタフライ弁で構成される開閉弁１８が、その弁軸１９を上記上流側湾曲部１３の湾曲面に直交する方向に向け、且つ該上流側湾曲部１３の外周壁１３a寄りに位置する周縁部１８aを上記弁軸１９よりも下流側に位置せしめた状態で配置されている。
【００４６】尚、上記上流側湾曲部１３は、図２に示すように、上記プライマリー通路１１側の上流側湾曲部２２(図２及び図３参照)と並設状態で一体的に形成されるとともに、各気筒の吸気通路１０,１０との間においては上下一対のフランジ４１,４２によって相互に連結されて一つの吸気マニホールド３０を構成している。
【００４７】さらに、上記上流側湾曲部１３の下流端近傍のしかも外周壁１３a寄り部位には、図１及び図３に示すように、該上流側湾曲部１３内への燃料導入を行う噴孔２６が、上記直線部１４を通して上記吸気ポート８に指向するようにして形成されるとともに、該噴孔２６の上流端側にはインジェクター２５が配置されている。尚、このような噴孔２６は上記プライマリー通路１１の

上流側湾曲部２２にも同様にして形成されており、該インジェクター２５から噴射される燃料はこの二つの噴孔２６,２６を通して上記プライマリー通路１１側とセカンダリー通路１２側の双方に同時に供給されるようになっている。

【００４８】一方、上記吸気マニホールド３０は、図１及び図２に示すように、上記上流側湾曲部１３の内周壁１３bの外側位置に、その内部にブローバイガス通路３５とアシストエア通路３７とを並設した横設部３１を、各気筒の吸気通路１０,１０,１０を横方向に跨がらせた状態で一体形成している。そして、このブローバイガス通路３５は、上記上流側湾曲部１３の内周壁１３bを貫通して形成した噴出部３６を介して上記噴孔２６よりも上流側の内周壁１３b上に開口せしめられており、排気通路１６側から導入されるブローバイガスG(特許請求の範囲中の付加ガスに該当する)はこのブローバイガス通路３５によって各気筒側に分流されるとともに、それぞれ噴出部３６,３６,・・から対応する気筒のセカンダリー通路１２内にそれぞれ導入されるようになっている。さらに、上記アシストエア通路３７は、上記吸気マニホールド３０内に形成された連通路３８を介して上記噴孔２６の最上流部分に連通せしめられており、該アシストエア通路３７に供給されたアシストエアは各気筒側にそれぞれ分流された後、連通路３８から噴孔２６の最上流部分に供給されるようになっている。

【００４９】続いて、このように構成された吸気装置の作動及び効果等について、主としてセカンダリー通路１２側の流れを例にとって説明する。エンジンが運転されると、先ずその低負荷域においては開閉弁１８が閉弁保持されるため、吸気はプライマリー通路１１側からのみ燃焼室７に導入され、該燃焼室７内にはスワール流が発生する。またこの場合、インジェクター２５からはプライマリー通路１１とセカンダリー通路１２の両方にそれぞれ燃料が分流供給されることから、プライマリー通路１１側からは吸気と燃料との混合気が、またセカンダリー通路１２側からは燃料のみが、それぞれ導入される。さらに、これとは別に、アシストエア通路３７に供給されたアシストエアが連通路３８を通ってインジェクター２５の噴口周辺に供給され、燃料と吸気のミキシングの促進及び燃料の気化・霧化が図られる。また、ブローバイガス通路３５に供給されたブローバイガスは噴出部３６からセカンダリー通路１２の上流側湾曲部１３部分に導入されている(従って、厳密には、このセカンダリー通路１２からは燃焼室７に対してブローバイガスと燃料との混合気が導入されることになる)。

【００５０】一方、エンジン負荷が上昇して高負荷運転域に達すると、上記開閉弁１８が開弁することから、燃焼室７にはプライマリー通路１１とセカンダリー通路１２の双方から吸気と燃料の混合気がそれぞれ導入される。また、これとは別に、上記セカンダリー通路１２の

上流側湾曲部１３部分には噴出部３６からブローバイガスが導入される。

【００５１】ここで、この場合におけるセカンダリー通路１２内での吸気とブローバイガスの流れ、及び燃料のミキシング作用等についてそれぞれ説明する。先ず、吸気の流れであるが、吸気はサージタンク１７から開閉弁１８を通ってセカンダリー通路１２側に流入した後、該セカンダリー通路１２内をその上流側湾曲部１３から直線部１４を経て下流側湾曲部１５に至り、最終的に吸気ポート８から燃焼室７内に吸入される。この場合、上記上流側湾曲部１３が大きく湾曲していることから、吸気流の慣性力に起因する二次流れにより該上流側湾曲部１３内における流速分布は図４における流速分布曲線L_1で示すように外周壁１３a側に最大流速が偏った状態となる。そして、この流速分布の偏りは、開閉弁１８の開弁時において最も顕著となる。即ち、該開閉弁１８はその湾曲部外周寄りの外周縁１８aが吸気下流側に位置するようにして開弁作動することから、上記サージタンク１７からの吸気はこの開閉弁１８を通過する際に該開閉弁１８によって湾曲部外周寄りに偏流する作用を受けるためである。従って、この場合には最も高い最大流速が達成される。

【００５２】そして、従来構造であれば、このような偏った流速分布は吸気が上流側湾曲部１３内を流通する間はそのまま持続されるが、この実施例においては該上流側湾曲部１３の通路途中においてその内周壁面１３b上に噴出部３６を形成してここからブローバイガスを上流側湾曲部１３内に導入させるようにしていることから、上記流速分布は吸気の流下に伴って次第に変化する。

【００５３】即ち、噴出部３６より上流側においては図４の流速分布曲線L_1で示すような流速分布をもち、従って上流側湾曲部１３の内周壁面１３b近傍はその吸気流Aによる動圧が低くなっており、ブローバイガスGはここからスムーズに上流側湾曲部１３内に導入される。この内周壁面１３bの近傍に導入されたブローバイガスGは、これがそのまま該上流側湾曲部１３内の吸気流によって下流側に押し流されることにより吸気流Aに付加された格好となり、結果的に噴出部３６の直下流側においては、図４の流速分布曲線L_2で示すように、外周壁面１３a寄り位置と内周壁面１３b寄り位置の両方にそれぞれ高流速域をもった“二こぶラクダ”状の流速分布となる。

【００５４】しかし、このような“二こぶラクダ”状の流速分布はそのままいつまでも持続されるものではなく、吸気の流下とともに二次流れの影響を受けて内周壁面１３b寄りの高流速域が次第に外周壁面１３a側に押し出され、図４の流速分布曲線L_3で示すように外周壁面１３a寄りと内周壁面１３b寄りとにおいてさほど大きな流速差のない略台形状の流速分布を呈することとなる。従って、このような流速分布となった状態においては、

外周壁面１３a寄り位置における最大流速にはほとんど変化がない一方、上流側湾曲部１３内における平均流速は大幅に上昇することとなる。このように平均流速が上昇するということは、上流側湾曲部１３のうち、吸気導入に有効に寄与し得る断面積が増加する(換言すれば、有効断面積の利用効率が高まる)ことであり、それだけ多量に且つ高速で吸気導入を行うことができ、結果的に吸気の充填効率の向上、延いては出力性能の向上につながるものである。尚、このようにブローバイガスの噴出部３６の下流側における流速分布が改善されると、この影響はそれより下流側のみに止どまらず、該噴出部３６よりも上流側にも及んでその部分の流速分布も改善されることは勿論である。

【００５５】尚、ブローバイガスの付加によって達成される内周壁面１３b寄りの高流速域は、吸気の流下に従って次第に外周壁面１３a側に移動することから、ブローバイガスの噴出部３６の形成位置からある程度下流寄り位置において図４の流速分布曲線L₂で示すような最も高い平均流速が得られるような流速分布となり、それよりさらに下流に下るに従って再び流速分布の外周壁面１３a側への偏りが顕著となって、最終的には最大流速のみが突出した流速分布となり充填効率という点からは望ましくない状態となる。このため、この実施例においては、図４の流速分布曲線L₂の如き流速分布が得られる位置の近傍に上流側湾曲部１３の下流端位置を設定するとともに、この部分に上記インジェクター２５の噴孔２６を開口させるようにしている。

【００５６】一方、インジェクター２５からの噴射燃料は、これが上記流速分布曲線L₂の如き流速分布が得られる位置のしかも外周壁面１３a寄りに開口した噴孔２６から直線部１４の軸心方向に向けて供給されることから、該燃料は流速の最も大きい部分の吸気に乗り、該吸気とのミキシングが促進されることから該燃料の気化・霧化状態が可及的に良好ならしめられ、延いてはエンジンの燃焼性能の改善に寄与できるものである。

【００５７】また、ブローバイガスの流れをみると、該ブローバイガスは上流側湾曲部１３内への導入とともに次第に二次流れによって外周壁面１３a側に移動せしめられるが、これはブローバイガスが全体的に外周壁面１３a側に移動するというのではなく、次第に吸気と混合しながら移動するということである。従って、セカンダリー通路１２内の流れ全体からみれば、上流側湾曲部１３の内周壁面１３b寄りに導入されたブローバイガスGのセカンダリー通路１２内における密度分布は、その下流端(即ち、吸気ポート８)に至るまで依然として内周壁面１３b寄り側が高く、外周壁面１３a寄り側が低くなっている。このため、上流側湾曲部１３の下流端近傍から直線部１４にかけての吸気温度(厳密には、吸気とブローバイガスとの混合気温度)は、該上流側湾曲部１３の内周壁面１３b寄り部分が高くなっており、また壁温についても同様である。

【００５８】従って、噴孔２６から上流側湾曲部１３内に噴射された燃料は、高流速の吸気流に乗って燃焼室７側に運ばれこと、及び上記内周壁面１３a側においてはその温度(壁温及び雰囲気温度の双方)が高くこの部分における燃料の気化・霧化性が良好であることから、該内周壁面１３b側の壁面(直線部１４及び下流側湾曲部１５の壁面も含む)への燃料付着が可及的に防止され、延いては燃料制御に対するエンジン出力の応答性が改善されるものである。

【００５９】さらに、セカンダリー通路１２内においては、上述のように上流側湾曲部１３の外周壁面１３a寄り部分を主として吸気が、内周壁面１３b寄りを主としてブローバイガスが流れるが、この場合、この実施例のように直線部１４がかなり大きな傾斜をもって吸気ポート８側に指向するとともに、これに続く下流側湾曲部１５を燃焼室７の軸心方向へ向けて湾曲させると、吸気ポート８から燃焼室７内に吸入される混合気は該燃焼室７内において上下方向に旋回するいわゆるタンブル流を生成する。ところで、この実施例のものにおいては、上述のように上流側湾曲部１３の内周壁面１３b寄りに主として存在したブローバイガスGはそのまま該内周壁面１３b側に位置する直線部１４の壁面及び下流側湾曲部１５の壁面に沿って燃焼室７内に流入することから、該燃焼室７内においてはブローバイガスGが該燃焼室７の内壁あるいはピストン６の頂面に近い側に層状に存在し、吸気と燃料の混合気Bはこのブローバイガス層の内部に包み込まれた状態で存在することとなる。即ち、燃焼室７内における層状化が達成されるものである。

【００６０】従って、混合気の層状化による希薄燃焼の実現により燃比性能が向上せしめられることは勿論であるが、さらにこれに加えて排気エミッション及びノッキング性能の改善も同時に図られるものである。即ち、このように燃焼室７の外周部、即ち、比較的温度が低くて燃焼不良により未燃成分が発生し易い部位がブローバイガスという不燃ガスによって占有されることから該部分への混合気の流入がなく、従って当然この部分においての燃焼ということもなく、結果的に未燃成分の発生そのものが可及的に抑制され、排気エミッションの改善につながるものである。また、このように燃焼室７の外周部がブローバイガスによって占有されるということは、ノッキング発生の遠因となるエンドガスゾーンそのものが消滅することから、ノッキング発生が可及的に防止され、延いては高圧縮比化による出力性能の改善も期待できるものである。

【００６１】さらに、エンジンの低負荷領域においては上記開閉弁１８は閉弁保持されるが、この開閉弁１８がバタフライ弁で構成されていることから、例えこれが全閉状態にあったとしてもその周縁部と通路壁との間には微少隙間が形成される。従って、開閉弁１８の閉弁状態

時においては、この隙間から吸気ポート８側に少量ずつ吸気が漏れ出ることとなる。一方、この開閉弁１８は、従来一般には吸気ポート８に近い位置に配置されるが、この実施例においてはこれを上流側湾曲部１３の上流端近傍に配置しているため、該開閉弁１８と吸気弁２０との間のボリュームは従来構造に比してかなり大きくなっており、従って上記開閉弁１８の隙間から漏れてこのボリューム内に溜る吸気量も大幅に増加する。このように、上記ボリューム内に多量の吸気が溜っていると、排気行程の最終期において吸気弁２０と排気弁２１の開弁がオーバラップした時には吸気ポート８から燃焼室７内に多量の吸気が流入し、この流入吸気により排気ポート９周辺が効率良く掃気されることとなる。

【００６２】また、ブローバイガス通路３５とアシストエア通路３７とが横設部３１内に近接状態で並設されていることから、該アシストエア通路３７内のアシストエアはブローバイガスの熱によって暖められたのちインジェクター２５の噴口近傍に供給されることから、該アシストエアによる燃料の気化・霧化の促進作用がより一層高められることとなる。また、このブローバイガス通路３５とアシストエア通路３７を形成した横設部３１が、吸気マニホールド３０の各吸気通路１０,１０,・・間をシリンダ配列方向に跨った状態で形成されていることにより、該吸気マニホールド３０はその上下両端がそれぞれフランジ４１,４２によって連結されるのに加えて、該横設部３１によってその中間部も連結されることから、その剛性が向上せしめられるものである。そして、この吸気マニホールド３０の剛性アップにより、エンジン全体としての剛性が高められ、且つエンジン振動による騒音発生も可及的に低減されるものである。

【００６３】尚、上記実施例においては、付加ガスとし＊

＊てブローバイガスを導入するようにしているが、本願発明はこれに限定されるものではなく、例えばこのブローバイガスに変えて付加ガスとしてＥＧＲガスを採用することもできるものである。

【００６４】また、この実施例においては、付加ガスの噴出部３６をセカンダリー通路１２側に形成しているが、本願発明はこれに限定されるものではなく、例えばこれをプライマリー通路１１側に形成することもできるものである。

【図面の簡単な説明】

【図１】本願発明の実施例にかかる吸気装置を備えたエンジンの要部断面図である。

【図２】図１のII-II矢視図である。

【図３】図１のIII-III縦断面図である。

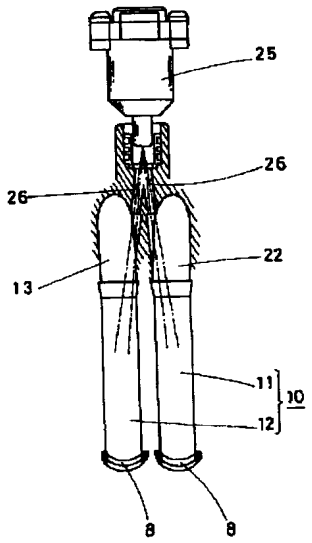
【図４】吸気通路内における吸気の流速分布説明図である。

【図５】吸気通路内における吸気の流速分布説明図である。

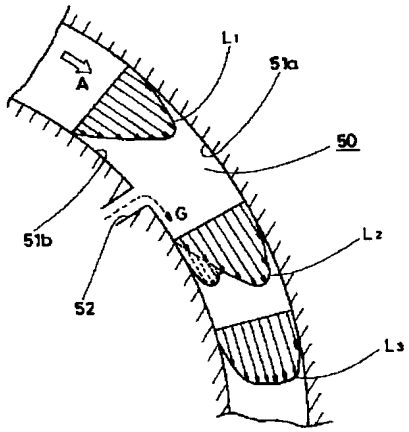
【符号の説明】

１はシリンダブロック、２はシリンダヘッド、３はカムキャリア、４はカムキャリア、５はヘッドカバー、６はピストン、７は燃焼室、８は吸気ポート、９は排気ポート、１０は吸気通路、１１はプライマリー通路、１２はセカンダリー通路、１３は上流側湾曲部、１４は直線部、１５は下流側湾曲部、１６は排気通路、１７はサージタンク、１８は開閉弁、１９は弁軸、２０は吸気弁、２１は排気弁、２３はカムシャフト、２４はカムシャフト、２５はインジェクター、２６は噴孔、３０は吸気マニホールド、３１は横設部、３５はブローバイガス通路、３６は噴出部、３７はアシストエア通路である。

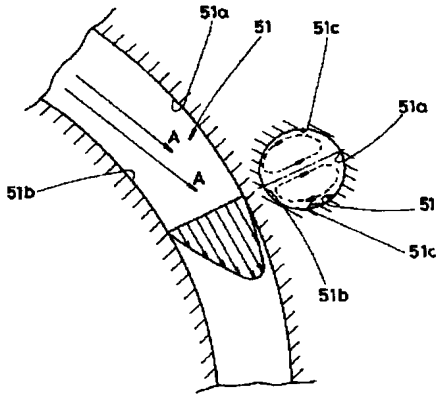
【図３】



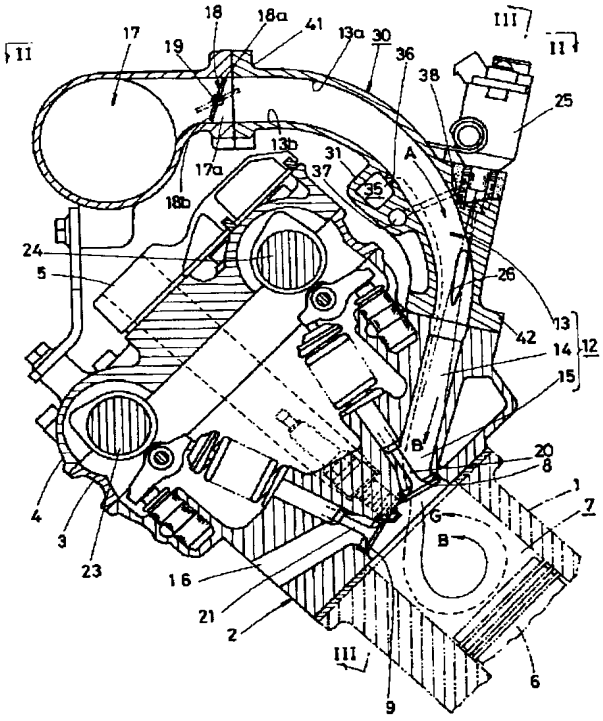
【図４】



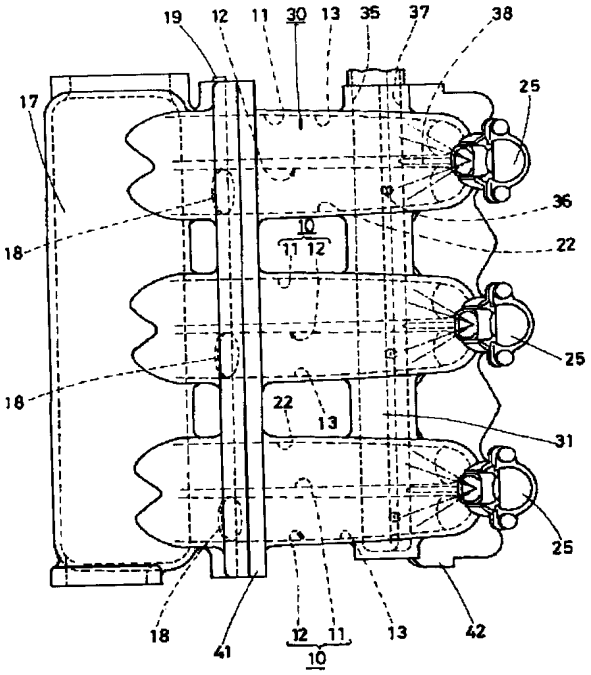
【図５】



【図１】



【図２】



フロントページの続き

(51)Int.Cl.⁷	識別記号	FI		
Ｆ０２Ｍ	29/00	Ｆ０２Ｍ	29/00	Ｇ
	69/04		69/04	Ｇ
				Ｐ
			69/00	３５０Ｔ

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実開　昭63－202769（ＪＰ，Ｕ）
実開　昭63－200655（ＪＰ，Ｕ）
実開　平１－130057（ＪＰ，Ｕ）

(58)調査した分野(Int.Cl.⁷，ＤＢ名)

F02M　69/00 - 69/00　310
F02M　69/04
F02M　25/07　580
F02M　29/00